

ADDENDUM REPORT
TRAFFIC IMPACT ASSESSMENT

351 SUMMER STREET
SOMERVILLE, MA

FEBRUARY, 2010

Prepared for

Strategic Capital Partners, LLC

Prepared by

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1.0 Introduction

This Addendum Report has been prepared to update the traffic impacts associated with the proposed development at 351 Summer Street in Somerville, MA. Since the initial submittal of the Traffic Impact Assessment dated July, 2009 a number of modifications to the development plan have occurred that require an update. These modifications include the following:

- Revised trip generation for trips associated with the newly proposed residential development – now set at 34 condominium units only. Also identify the potential trip generation for the space vacated by the Dilboy Post at adjacent 371 Summer Street.
- A more detailed description of the assignment of trips for the new Dilboy Post building usage as related to the updated site development plan
- An updated safety and operational assessment of proposed site access off Summer Street, with three (3) separate site driveways now proposed for the site development.

This addendum analysis also includes field verification of the traffic counts that were performed in July, 2009 at the three signalized intersections in the vicinity of the project site.

Trip Generation and Distribution

The trip generation for the 34 residential condominium units now proposed is shown in the following table.

<u>34 Units</u> <u>Residential Condominium/Townhouse</u> <u>Land Use 230</u>		
Daily	AM Peak Hour	PM Peak Hour
In – 99	In – 3	In – 12
Out – 100	Out – 12	Out – 6
Total – 199	Total – 15	Total – 18

The development plan calls for relocation of the existing Dilboy Post that currently occupies approximately 3,911 GSF of space at 371 Summer Street. Since this area has the potential of being occupied as office space within current zoning, the future development condition should consider this additional component. If needed, parking for this use would use designated Dilboy stalls under the proposed development plan that would be available for daytime use. The following tables identify the Trip Generation for this future potential use and the total development scenario.

<u>Potential Future Use</u> <u>3,911 General Office</u> <u>Land Use 710</u>		
Daily	AM Peak Hour	PM Peak Hour
In – 22	In – 5	In – 1
Out – 21	Out – 1	Out – 5
Total – 43	Total – 6	Total – 6

<u>Total</u> <u>34 Residential Units and 3,911 SF Office</u>		
Daily	AM Peak Hour	PM Peak Hour
In – 121	In – 8	In – 13
Out – 121	Out – 13	Out – 11
Total – 242	Total – 21	Total – 24

The estimate for total site-generated trips is close to equivalent with the estimate from the previous study (as referenced below) that included 30 residential units and 4,800 SF of office space. Daily trips will be slightly higher, while total peak hour trips amount to one additional trip per hour.

<u>Previous Development (July,2009)</u> <u>30 Residential Units and 4,800 SF Office</u>		
Daily	AM Peak Hour	PM Peak Hour
In – 114	In – 8	In – 12
Out – 114	Out – 12	Out – 11
Total – 228	Total – 20	Total – 23

As described in the July 2009 report, the site generated peak hour trips have been distributed on the study area intersections based upon existing travel patterns within the study area and routes to major arterials in the area. An update of the site generated peak hour trips are shown on Figure 5-A (see Appendix) that identifies the traffic use at the three proposed site drives.

Dilboy Post Activity

The Post runs approximately 170 events per year (which translates to an average of 14 events per month). These events range from community service fundraisers (like Habitat for Humanity and Avon walk for cancer) to birthday parties, christenings, communions,

graduations, reunions, and funerals to a once a year Beer and Honk Festival. The hall is also a polling station. Except for very few annually scheduled events, the rest are all booked through their membership on a first-come-first-serve basis, a few weeks or a few days in advance.

The great majority of events have no more than 80 guests, but they range from 20 to over 100 guests. The Post also has a club where members gather for cards and other games. The club is frequented every day almost without exception by small gatherings. They have a license to serve liquor.

Closing time of the Post is 1 AM, but most often they close earlier.

Parking for the existing Dilboy Post is provided on the west lot with entries/exits via the existing 2 driveways off Summer Street. The relocated facility will continue to have access off Summer Street only. Future activities are expected not to exceed current levels per agreement with the City of Somerville.

Updated Site Development Plan

The current development plan calls for three separate curb cuts onto Summer Street as follows:

- West Driveway accessing rear surface parking on the west lot – a total of 46 parking spaces (for combined Dilboy Post and commercial users, visitor parking and one resident space.
- Center Driveway accessing underground resident parking – a total of 45 parking stalls.
- East Driveway accessing 22 parking spaces for the new Dilboy Post building on the east lot.

Sight distance at all of the site driveways will be well in excess of the minimum 150 feet stopping sight distance for the 25 mph operating speed along Summer Street. This is due to the straight horizontal and relatively flat vertical alignment of Summer Street along the site frontage, combined with the 10 foot setback of the proposed residential building from the back of sidewalk.

The location of the eastern site driveway opposite Elston Street is aligned slightly to the west. This results in a slight diversion for traffic movements from Elston Street, crossing Summer Street, to enter the driveway. Since the movement is relatively direct (less than 30 degrees diversion) the condition should not contribute to unsafe operations and is considered acceptable.

Verification of Traffic Counts

This addendum analysis also includes field verification of the traffic counts that were performed in July, 2009 for the three signalized intersections in the vicinity of the project

site. As shown on the following Table A; similar traffic levels were found at all locations except for the intersection of Highland and Willow Avenue where higher activity was observed.

Table A – Peak Hour Weekday Volume Counts

Street Segment	July 2009	February 2010	Difference
	AM/PM	AM/PM	AM/PM
Summer Street Eastbound (approaching site)	190/180	188/189	-2/+9
Summer Street Eastbound (approaching Willow Ave)	176/171	162/159	-14/-12
Willow Ave Northbound (approaching Highland Ave)	310/472	345/564	+35/+92
Highland Ave. EB and WB (approaching Willow Ave)	477/681	594/709	+117/+28

Analysis for the intersection of Highland and Willow Avenue was therefore updated to reflect the higher volume condition. The results are shown on Table B. Revised graphics for the Existing and 2014 No-Build and Build Conditions are contained in the attached Appendix, as well as SYNCHRO analysis worksheets.

Table B – Level of Service

SIGNALIZED INTERSECTION												
	2014 No-Build						2014 Build					
	AM Peak Hour			PM Peak Hour			AM Peak Hour			PM Peak Hour		
	V/C	Delay	LOS	V/C	Delay	LOS	V/C	Delay	LOS	V/C	Delay	LOS
Willow/Highland												
Highland EB	.49	12.0	B	.87	28.2	C	.50	12.1	B	.87	28.2	C
Highland WB	.70	15.7	B	.58	12.7	B	.70	15.8	B	.59	12.8	B
Willow NB	.46	7.9	A	.76	15.0	B	.47	8.0	A	.77	15.7	B
Willow SB	.40	7.6	A	.20	6.6	A	.40	7.6	A	.20	6.7	A
OVERALL	.55	10.9	B	.80	16.9	B	.55	11.0	B	.81	17.2	B

- (1) Volume/Capacity Ratio
 (2) Control Delay in Seconds
 (3) Level-of-Service

As seen on Table B, no changes in Level-of-Service occur from the No-Build to Build conditions. The results show that the increase in average delays will be one second or less for all traffic movements.

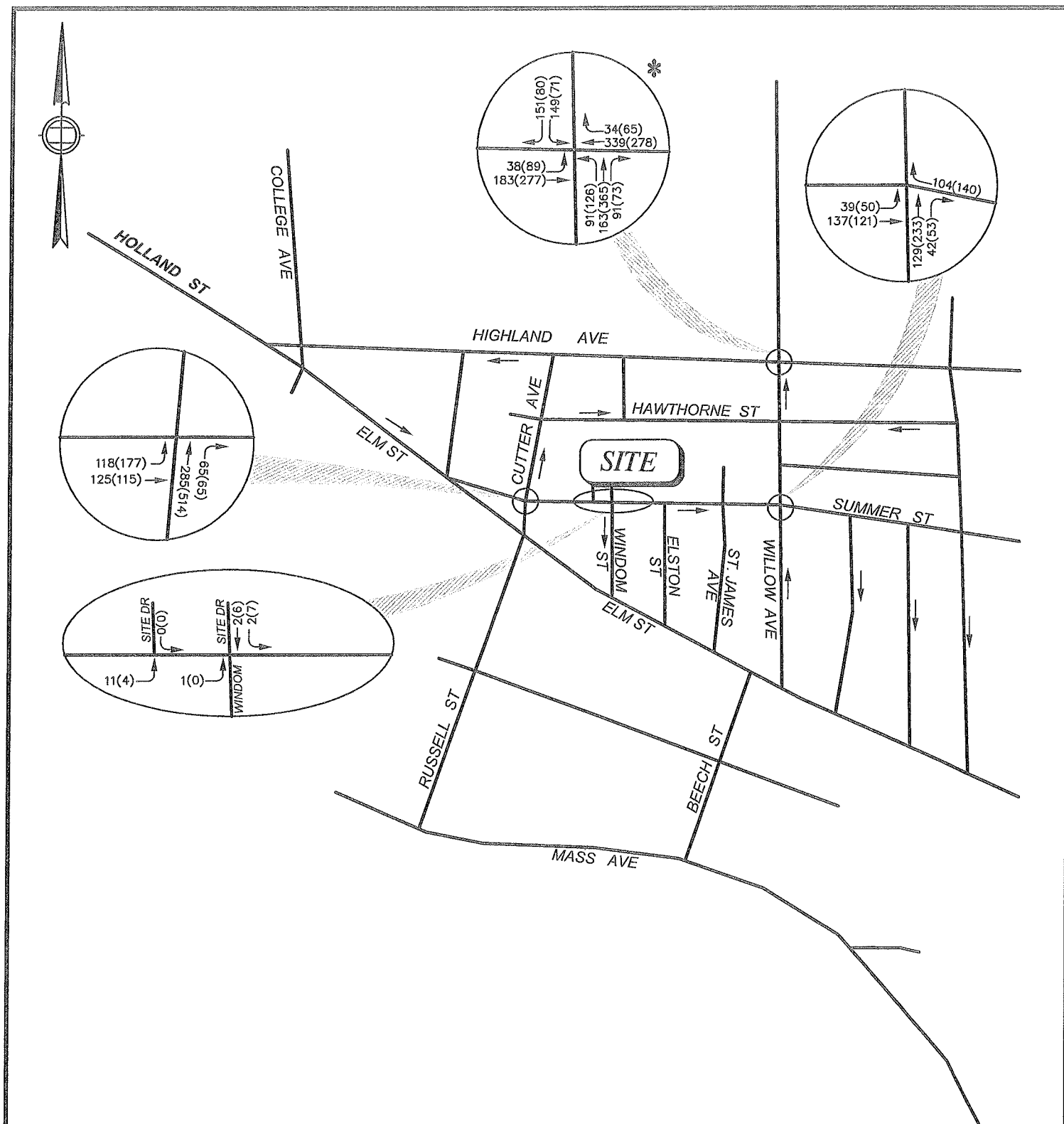
Conclusions

This update for the proposed site development confirms that the low volumes generated by the proposed development during the peak hours will have little measureable impacts on traffic flows along Summer Street and the surrounding roadways. Peak hour directional site traffic (12 vehicles per hour) will amount to approximately one vehicle every five minutes at the main driveway connecting to the underground garage. It should also be noted that these peak hour site trips are expected to be less. This is due to the nearby MBTA Red Line station at Davis Square that will encourage both residents and other users at the site to use transit.

Trip generation studies published by ITE show that peak hour rates for residential and office development coincide with the peak commute periods of adjacent traffic from 7:00 to 9:00 AM and 4:00 to 6:00 PM. Site traffic during off-peak periods will therefore be somewhat lower throughout the day and also reflect the lower traffic volumes on the adjacent roadways (typically about one half of peak hour activity).

The Dilboy Post will continue activities at its new location along Summer Street, with peak traffic activity occurring during off-peak hours that can be well accommodated by the surrounding street network.

APPENDIX



* COUNT DATE: FEB, 2010

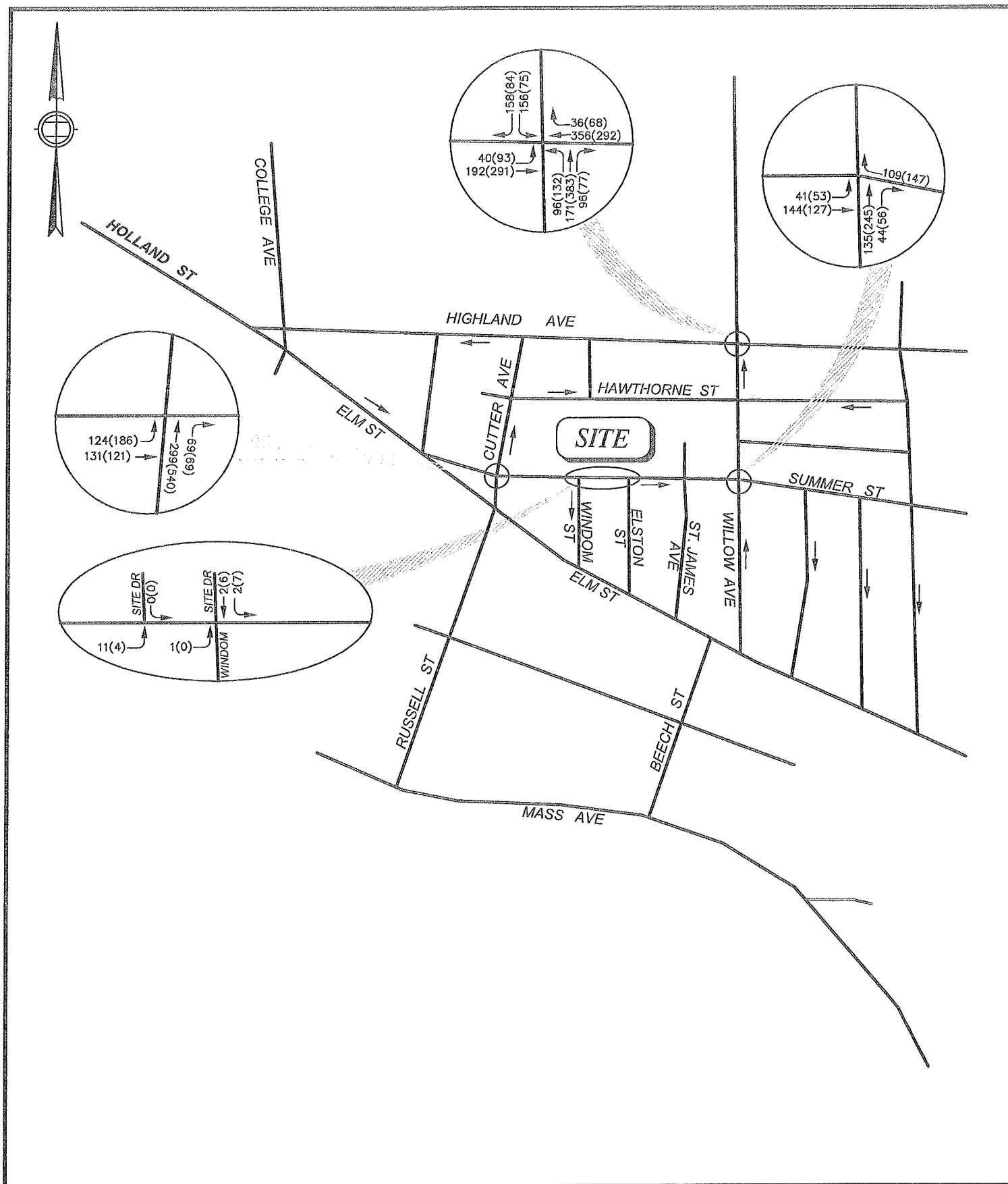
COUNT DATE: JULY, 2009
N.T.S.

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351 SUMMER ST
SOMERVILLE, MA

EXIST PEAK HOUR
TRAFFIC VOLUME
AM(PM)

FIGURE 2-A



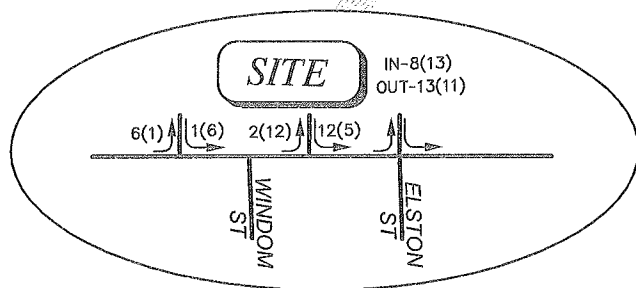
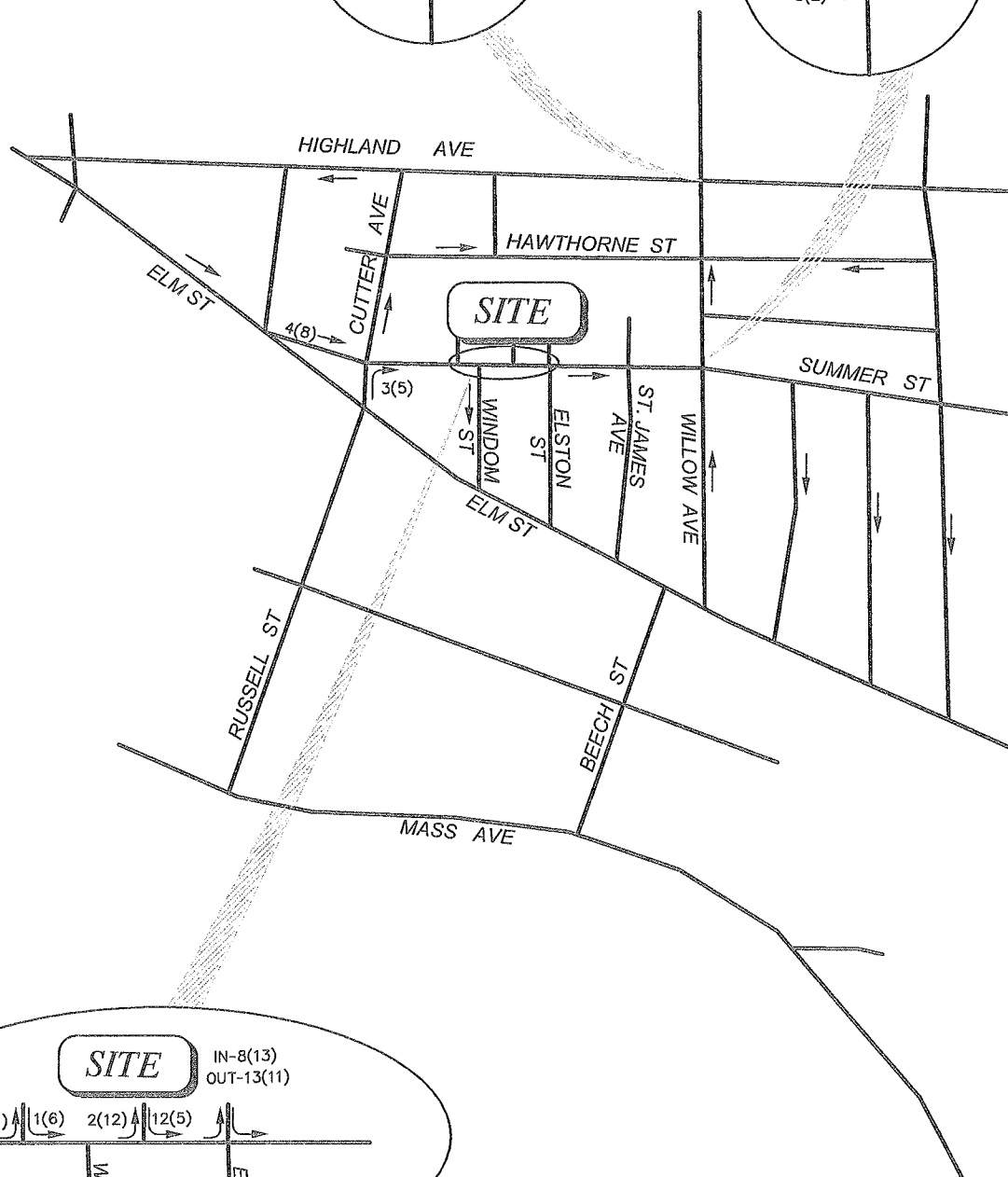
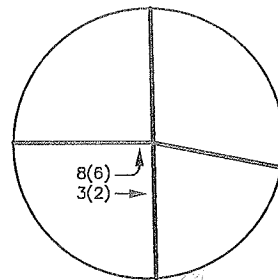
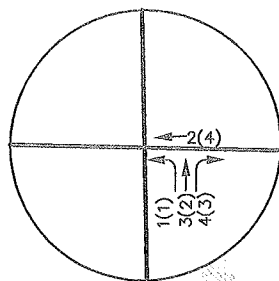
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**351 SUMMER ST
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**2014 NO-BUILD
PEAK HOUR
TRAFFIC VOLUME
AM(PM)**

FIGURE 3-A

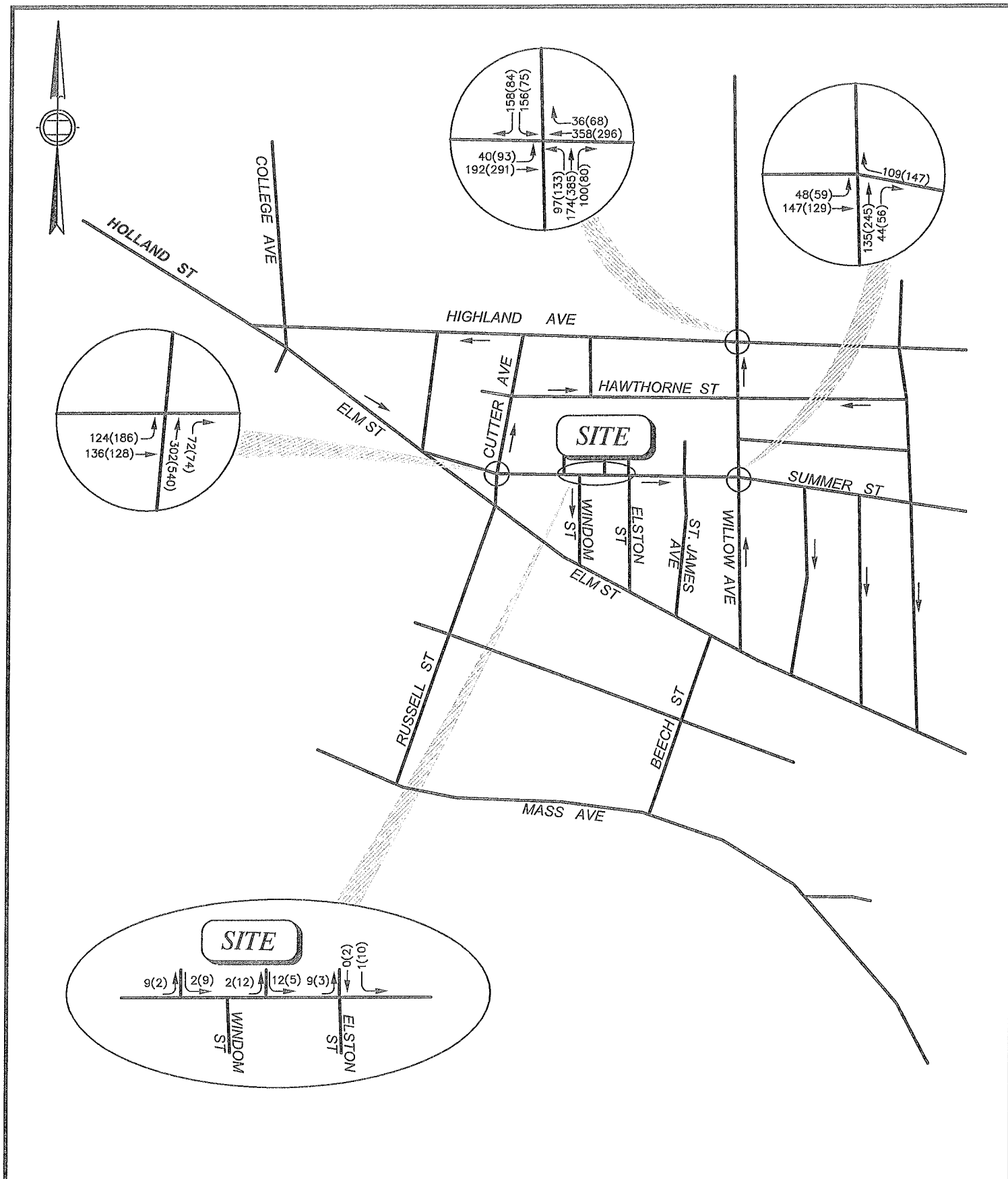


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351 SUMMER ST
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SITE-GENERATED
PEAK HOUR TRIPS
AM(PM)

FIGURE 5-A



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351 SUMMER ST
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2014 BUILD
PEAK HOUR TRIPS
AM(PM)

FIGURE 6-A

Queues
3: HIGHLAND & WILLOW

















2008-038 Summer St
2009 AM Exist

	→	←	↑	↓
Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	240	405	375	326
v/c Ratio	0.46	0.68	0.44	0.43
Control Delay	14.2	18.0	7.8	5.8
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	14.2	18.0	7.8	5.8
Queue Length 50th (ft)	43	76	39	19
Queue Length 95th (ft)	87	143	100	65
Internal Link Dist (ft)	730	1353	144	546
Turn Bay Length (ft)				
Base Capacity (vph)	671	767	846	751
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.36	0.53	0.44	0.43
Intersection Summary				

HCM Signalized Intersection Capacity Analysis

3: HIGHLAND & WILLOW

2008-038 Summer St
2009 AM Exist

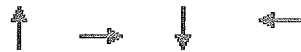
												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	38	183	0	0	339	34	91	163	91	149	0	151
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		3.0			3.0			3.0			3.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			0.99			0.96			0.93	
Flt Protected		0.99			1.00			0.99			0.98	
Satd. Flow (prot)		1847			1840			1773			1694	
Flt Permitted		0.87			1.00			0.85			0.73	
Satd. Flow (perm)		1624			1840			1533			1267	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	41	199	0	0	368	37	99	177	99	162	0	164
RTOR Reduction (vph)	0	0	0	0	9	0	0	26	0	0	73	0
Lane Group Flow (vph)	0	240	0	0	396	0	0	349	0	0	253	0
Turn Type	Perm						Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4						2			6		
Actuated Green, G (s)		13.2			13.2			22.1			22.1	
Effective Green, g (s)		13.2			13.2			22.1			22.1	
Actuated g/C Ratio		0.32			0.32			0.54			0.54	
Clearance Time (s)		3.0			3.0			3.0			3.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		519			588			820			678	
v/s Ratio Prot					c0.22							
v/s Ratio Perm		0.15						c0.23			0.20	
v/c Ratio		0.46			0.67			0.43			0.37	
Uniform Delay, d1		11.2			12.2			5.8			5.6	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.7			3.0			1.6			1.6	
Delay (s)		11.9			15.2			7.4			7.1	
Level of Service		B			B			A			A	
Approach Delay (s)		11.9			15.2			7.4			7.1	
Approach LOS		B			B			A			A	

Intersection Summary

HCM Average Control Delay	10.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	41.3	Sum of lost time (s)	6.0
Intersection Capacity Utilization	73.3%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Timing Report, Sorted By Phase
3: HIGHLAND & WILLOW

2008-038 Summer St
2009 AM Exist







Phase Number	2	4	6	8
Movement	NBTL	EBTL	SBTL	WBT
Lead/Lag				
Lead-Lag Optimize				
Recall Mode	Max	None	Max	None
Maximum Split (s)	25	20	25	20
Maximum Split (%)	55.6%	44.4%	55.6%	44.4%
Minimum Split (s)	17	9	17	9
Yellow Time (s)	2	2	2	2
All-Red Time (s)	1	1	1	1
Minimum Initial (s)	4	4	4	4
Vehicle Extension (s)	3	3	3	3
Minimum Gap (s)	3	3	3	3
Time Before Reduce (s)	0	0	0	0
Time To Reduce (s)	0	0	0	0
Walk Time (s)				
Flash Dont Walk (s)				
Dual Entry	Yes	Yes	Yes	Yes
Inhibit Max	Yes	Yes	Yes	Yes
Start Time (s)	0	25	0	25
End Time (s)	25	0	25	0
Yield/Force Off (s)	22	42	22	42
Yield/Force Off 170(s)	22	42	22	42
Local Start Time (s)	0	25	0	25
Local Yield (s)	22	42	22	42
Local Yield 170(s)	22	42	22	42

Intersection Summary

Cycle Length	45
Control Type	Actuated-Uncoordinated
Natural Cycle	40

Splits and Phases: 3: HIGHLAND & WILLOW

 25 s	 20 s
 25 s	 20 s



Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	398	373	613	164
v/c Ratio	0.82	0.58	0.72	0.24
Control Delay	29.9	14.4	15.3	4.6
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	29.9	14.4	15.3	4.6
Queue Length 50th (ft)	85	65	110	10
Queue Length 95th (ft)	#204	125	#267	33
Internal Link Dist (ft)	730	1353	144	546
Turn Bay Length (ft)				
Base Capacity (vph)	557	739	856	692
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.71	0.50	0.72	0.24

















Intersection Summary

- # 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis

3: HIGHLAND & WILLOW

2008-038 Summer St
2009 PM Exist

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	89	277	0	0	278	65	126	365	73	71	0	80
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		3.0			3.0			3.0			3.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Flt		1.00			0.97			0.98			0.93	
Flt Protected		0.99			1.00			0.99			0.98	
Satd. Flow (prot)		1840			1815			1810			1690	
Flt Permitted		0.75			1.00			0.90			0.73	
Satd. Flow (perm)		1401			1815			1642			1265	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	97	301	0	0	302	71	137	397	79	77	0	87
RTOR Reduction (vph)	0	0	0	0	20	0	0	11	0	0	42	0
Lane Group Flow (vph)	0	398	0	0	353	0	0	602	0	0	122	0
Turn Type	Perm						Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4						2			6		
Actuated Green, G (s)		14.8			14.8			22.1			22.1	
Effective Green, g (s)		14.8			14.8			22.1			22.1	
Actuated g/C Ratio		0.34			0.34			0.52			0.52	
Clearance Time (s)		3.0			3.0			3.0			3.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		483			626			846			652	
v/s Ratio Prot					0.19							
v/s Ratio Perm		c0.28						c0.37			0.10	
v/c Ratio		0.82			0.56			0.71			0.19	
Uniform Delay, d1		12.9			11.4			8.0			5.6	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		10.9			1.2			5.0			0.6	
Delay (s)		23.8			12.6			13.0			6.2	
Level of Service		C			B			B			A	
Approach Delay (s)		23.8			12.6			13.0			6.2	
Approach LOS		C			B			B			A	

Intersection Summary

HCM Average Control Delay	15.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	42.9	Sum of lost time (s)	6.0
Intersection Capacity Utilization	80.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Timing Report, Sorted By Phase
3: HIGHLAND & WILLOW

2008-038 Summer St
2009 PM Exist







Phase Number	2	4	6	8
Movement	NBTL	EBTL	SBTL	WBT
Lead/Lag				
Lead-Lag Optimize				
Recall Mode	Max	None	Max	None
Maximum Split (s)	25	20	25	20
Maximum Split (%)	55.6%	44.4%	55.6%	44.4%
Minimum Split (s)	17	9	17	9
Yellow Time (s)	2	2	2	2
All-Red Time (s)	1	1	1	1
Minimum Initial (s)	4	4	4	4
Vehicle Extension (s)	3	3	3	3
Minimum Gap (s)	3	3	3	3
Time Before Reduce (s)	0	0	0	0
Time To Reduce (s)	0	0	0	0
Walk Time (s)				
Flash Dont Walk (s)				
Dual Entry	Yes	Yes	Yes	Yes
Inhibit Max	Yes	Yes	Yes	Yes
Start Time (s)	0	25	0	25
End Time (s)	25	0	25	0
Yield/Force Off (s)	22	42	22	42
Yield/Force Off 170(s)	22	42	22	42
Local Start Time (s)	0	25	0	25
Local Yield (s)	22	42	22	42
Local Yield 170(s)	22	42	22	42

Intersection Summary

Cycle Length	45
Control Type	Actuated-Uncoordinated
Natural Cycle	45

Splits and Phases: 3: HIGHLAND & WILLOW

 2	 4
25 s	20 s
 6	 8
25 s	20 s

Queues
3: HIGHLAND & WILLOW

















2008-038 Summer St
2014 AM NO-BUILD

	→	←	↑	↓
Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	252	426	394	342
v/c Ratio	0.50	0.70	0.47	0.46
Control Delay	14.8	18.7	8.4	6.3
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	14.8	18.7	8.4	6.3
Queue Length 50th (ft)	46	81	44	22
Queue Length 95th (ft)	93	152	107	71
Internal Link Dist (ft)	730	1353	144	546
Turn Bay Length (ft)				
Base Capacity (vph)	640	761	832	745
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.39	0.56	0.47	0.46
Intersection Summary				

HCM Signalized Intersection Capacity Analysis

3: HIGHLAND & WILLOW

2008-038 Summer St
2014 AM NO-BUILD

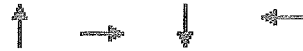
												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	40	192	0	0	356	36	96	171	96	156	0	158
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		3.0			3.0			3.0			3.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			0.99			0.96			0.93	
Flt Protected		0.99			1.00			0.99			0.98	
Satd. Flow (prot)		1847			1840			1773			1694	
Flt Permitted		0.84			1.00			0.85			0.73	
Satd. Flow (perm)		1564			1840			1521			1266	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	43	209	0	0	387	39	104	186	104	170	0	172
RTOR Reduction (vph)	0	0	0	0	9	0	0	26	0	0	74	0
Lane Group Flow (vph)	0	252	0	0	417	0	0	368	0	0	268	0
Turn Type	Perm						Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4						2			6		
Actuated Green, G (s)		13.6			13.6			22.1			22.1	
Effective Green, g (s)		13.6			13.6			22.1			22.1	
Actuated g/C Ratio		0.33			0.33			0.53			0.53	
Clearance Time (s)		3.0			3.0			3.0			3.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		510			600			806			671	
v/s Ratio Prot					c0.23							
v/s Ratio Perm		0.16						c0.24			0.21	
v/c Ratio		0.49			0.70			0.46			0.40	
Uniform Delay, d1		11.3			12.2			6.1			5.8	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.8			3.5			1.9			1.8	
Delay (s)		12.0			15.7			7.9			7.6	
Level of Service		B			B			A			A	
Approach Delay (s)		12.0			15.7			7.9			7.6	
Approach LOS		B			B			A			A	

Intersection Summary

HCM Average Control Delay	10.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.55		
Actuated Cycle Length (s)	41.7	Sum of lost time (s)	6.0
Intersection Capacity Utilization	76.3%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Timing Report, Sorted By Phase
3: HIGHLAND & WILLOW





2008-038 Summer St
2014 AM NO-BUILD



Phase Number	2	4	6	8
Movement	NBTL	EBTL	SBTL	WBT
Lead/Lag				
Lead-Lag Optimize				
Recall Mode	Max	None	Max	None
Maximum Split (s)	25	20	25	20
Maximum Split (%)	55.6%	44.4%	55.6%	44.4%
Minimum Split (s)	17	9	17	9
Yellow Time (s)	2	2	2	2
All-Red Time (s)	1	1	1	1
Minimum Initial (s)	4	4	4	4
Vehicle Extension (s)	3	3	3	3
Minimum Gap (s)	3	3	3	3
Time Before Reduce (s)	0	0	0	0
Time To Reduce (s)	0	0	0	0
Walk Time (s)				
Flash Dont Walk (s)				
Dual Entry	Yes	Yes	Yes	Yes
Inhibit Max	Yes	Yes	Yes	Yes
Start Time (s)	0	25	0	25
End Time (s)	25	0	25	0
Yield/Force Off (s)	22	42	22	42
Yield/Force Off 170(s)	22	42	22	42
Local Start Time (s)	0	25	0	25
Local Yield (s)	22	42	22	42
Local Yield 170(s)	22	42	22	42

Intersection Summary			
Cycle Length			45
Control Type	Actuated-Uncoordinated		
Natural Cycle			40

Splits and Phases: 3: HIGHLAND & WILLOW

 2	 4
25 s	20 s
 6	 8
25 s	20 s

Queues
3: HIGHLAND & WILLOW

2008-038 Summer St
2014 PM No-Build

	→	←	↑	↓
Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	417	391	643	173
v/c Ratio	0.87	0.59	0.76	0.25
Control Delay	34.5	14.7	17.6	4.7
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	34.5	14.7	17.6	4.7
Queue Length 50th (ft)	92	69	119	10
Queue Length 95th (ft)	#221	133	#289	35
Internal Link Dist (ft)	730	1353	144	546
Turn Bay Length (ft)				
Base Capacity (vph)	533	729	842	684
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.78	0.54	0.76	0.25

















Intersection Summary

- # 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis

3: HIGHLAND & WILLOW

2008-038 Summer St
2014 PM No-Build

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	93	291	0	0	292	68	132	383	77	75	0	84
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		3.0			3.0			3.0			3.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			0.97			0.98			0.93	
Flt Protected		0.99			1.00			0.99			0.98	
Satd. Flow (prot)		1840			1815			1810			1690	
Flt Permitted		0.73			1.00			0.89			0.73	
Satd. Flow (perm)		1360			1815			1636			1259	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	101	316	0	0	317	74	143	416	84	82	0	91
RTOR Reduction (vph)	0	0	0	0	19	0	0	12	0	0	45	0
Lane Group Flow (vph)	0	417	0	0	372	0	0	631	0	0	128	0
Turn Type	Perm						Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4						2			6		
Actuated Green, G (s)		15.4			15.4			22.1			22.1	
Effective Green, g (s)		15.4			15.4			22.1			22.1	
Actuated g/C Ratio		0.35			0.35			0.51			0.51	
Clearance Time (s)		3.0			3.0			3.0			3.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		481			643			831			640	
v/s Ratio Prot					0.20							
v/s Ratio Perm		c0.31						c0.39			0.10	
v/c Ratio		0.87			0.58			0.76			0.20	
Uniform Delay, d1		13.1			11.4			8.6			5.9	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		15.1			1.3			6.5			0.7	
Delay (s)		28.2			12.7			15.0			6.6	
Level of Service		C			B			B			A	
Approach Delay (s)		28.2			12.7			15.0			6.6	
Approach LOS		C			B			B			A	

Intersection Summary

HCM Average Control Delay	16.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	43.5	Sum of lost time (s)	6.0
Intersection Capacity Utilization	84.2%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Timing Report, Sorted By Phase
3: HIGHLAND & WILLOW

2008-038 Summer St
2014 PM No-Build



Phase Number	2	4	6	8
Movement	NBTL	EBTL	SBTL	WBT
Lead/Lag				
Lead-Lag Optimize				
Recall Mode	Max	None	Max	None
Maximum Split (s)	25	20	25	20
Maximum Split (%)	55.6%	44.4%	55.6%	44.4%
Minimum Split (s)	17	9	17	9
Yellow Time (s)	2	2	2	2
All-Red Time (s)	1	1	1	1
Minimum Initial (s)	4	4	4	4
Vehicle Extension (s)	3	3	3	3
Minimum Gap (s)	3	3	3	3
Time Before Reduce (s)	0	0	0	0
Time To Reduce (s)	0	0	0	0
Walk Time (s)				
Flash Dont Walk (s)				
Dual Entry	Yes	Yes	Yes	Yes
Inhibit Max	Yes	Yes	Yes	Yes
Start Time (s)	0	25	0	25
End Time (s)	25	0	25	0
Yield/Force Off (s)	22	42	22	42
Yield/Force Off 170(s)	22	42	22	42
Local Start Time (s)	0	25	0	25
Local Yield (s)	22	42	22	42
Local Yield 170(s)	22	42	22	42

Intersection Summary

Cycle Length	45
Control Type	Actuated-Uncoordinated
Natural Cycle	40

Splits and Phases: 3: HIGHLAND & WILLOW

↑ 2	→ 4
25 s	20 s
↓ 6	← 8
25 s	20 s

Queues
3: HIGHLAND & WILLOW

2008-038 Summer St
2014 AM BUILD



















Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	252	428	403	342
v/c Ratio	0.50	0.70	0.48	0.46
Control Delay	14.8	18.7	8.5	6.3
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	14.8	18.7	8.5	6.3
Queue Length 50th (ft)	46	82	45	22
Queue Length 95th (ft)	93	153	110	72
Internal Link Dist (ft)	730	1353	144	546
Turn Bay Length (ft)				
Base Capacity (vph)	637	760	833	743
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.40	0.56	0.48	0.46

Intersection Summary

HCM Signalized Intersection Capacity Analysis

3: HIGHLAND & WILLOW

2008-038 Summer St
2014 AM BUILD

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	40	192	0	0	358	36	97	174	100	156	0	158
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		3.0			3.0			3.0			3.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			0.99			0.96			0.93	
Flt Protected		0.99			1.00			0.99			0.98	
Satd. Flow (prot)		1847			1840			1772			1694	
Flt Permitted		0.84			1.00			0.85			0.73	
Satd. Flow (perm)		1557			1840			1522			1262	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	43	209	0	0	389	39	105	189	109	170	0	172
RTOR Reduction (vph)	0	0	0	0	9	0	0	27	0	0	74	0
Lane Group Flow (vph)	0	252	0	0	419	0	0	376	0	0	268	0
Turn Type	Perm						Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4						2			6		
Actuated Green, G (s)		13.6			13.6			22.1			22.1	
Effective Green, g (s)		13.6			13.6			22.1			22.1	
Actuated g/C Ratio		0.33			0.33			0.53			0.53	
Clearance Time (s)		3.0			3.0			3.0			3.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		508			600			807			669	
v/s Ratio Prot					c0.23							
v/s Ratio Perm		0.16						c0.25			0.21	
v/c Ratio		0.50			0.70			0.47			0.40	
Uniform Delay, d1		11.3			12.3			6.1			5.8	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.8			3.6			1.9			1.8	
Delay (s)		12.1			15.8			8.0			7.6	
Level of Service		B			B			A			A	
Approach Delay (s)		12.1			15.8			8.0			7.6	
Approach LOS		B			B			A			A	

Intersection Summary

HCM Average Control Delay	11.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.55		
Actuated Cycle Length (s)	41.7	Sum of lost time (s)	6.0
Intersection Capacity Utilization	76.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Timing Report, Sorted By Phase
3: HIGHLAND & WILLOW

2008-038 Summer St
2014 AM BUILD



Phase Number	2	4	6	8
Movement	NBTL	EBTL	SBTL	WBT
Lead/Lag				
Lead-Lag Optimize				
Recall Mode	Max	None	Max	None
Maximum Split (s)	25	20	25	20
Maximum Split (%)	55.6%	44.4%	55.6%	44.4%
Minimum Split (s)	17	9	17	9
Yellow Time (s)	2	2	2	2
All-Red Time (s)	1	1	1	1
Minimum Initial (s)	4	4	4	4
Vehicle Extension (s)	3	3	3	3
Minimum Gap (s)	3	3	3	3
Time Before Reduce (s)	0	0	0	0
Time To Reduce (s)	0	0	0	0
Walk Time (s)				
Flash Dont Walk (s)				
Dual Entry	Yes	Yes	Yes	Yes
Inhibit Max	Yes	Yes	Yes	Yes
Start Time (s)	0	25	0	25
End Time (s)	25	0	25	0
Yield/Force Off (s)	22	42	22	42
Yield/Force Off 170(s)	22	42	22	42
Local Start Time (s)	0	25	0	25
Local Yield (s)	22	42	22	42
Local Yield 170(s)	22	42	22	42

Intersection Summary

Cycle Length	45
Control Type	Actuated-Uncoordinated
Natural Cycle	40

Splits and Phases: 3: HIGHLAND & WILLOW



Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	417	398	650	173
v/c Ratio	0.87	0.60	0.78	0.25
Control Delay	34.9	14.8	18.3	4.8
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	34.9	14.8	18.3	4.8
Queue Length 50th (ft)	92	71	121	10
Queue Length 95th (ft)	#222	137	#294	35
Internal Link Dist (ft)	730	1353	144	546
Turn Bay Length (ft)				
Base Capacity (vph)	527	727	838	680
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.79	0.55	0.78	0.25

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.

















Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis

3: HIGHLAND & WILLOW

2008-038 Summer St

2014 PM Build

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	93	291	0	0	298	68	133	385	80	75	0	84
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		3.0			3.0			3.0			3.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		1.00			0.97			0.98			0.93	
Flt Protected		0.99			1.00			0.99			0.98	
Satd. Flow (prot)		1840			1816			1809			1690	
Flt Permitted		0.72			1.00			0.89			0.73	
Satd. Flow (perm)		1349			1816			1634			1256	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	101	316	0	0	324	74	145	418	87	82	0	91
RTOR Reduction (vph)	0	0	0	0	19	0	0	12	0	0	45	0
Lane Group Flow (vph)	0	417	0	0	379	0	0	638	0	0	128	0
Turn Type	Perm						Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4						2			6		
Actuated Green, G (s)		15.6			15.6			22.1			22.1	
Effective Green, g (s)		15.6			15.6			22.1			22.1	
Actuated g/C Ratio		0.36			0.36			0.51			0.51	
Clearance Time (s)		3.0			3.0			3.0			3.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		482			648			826			635	
v/s Ratio Prot					0.21							
v/s Ratio Perm		c0.31						c0.39			0.10	
v/c Ratio		0.87			0.59			0.77			0.20	
Uniform Delay, d1		13.1			11.4			8.8			5.9	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		14.9			1.4			6.9			0.7	
Delay (s)		28.0			12.8			15.7			6.7	
Level of Service		C			B			B			A	
Approach Delay (s)		28.0			12.8			15.7			6.7	
Approach LOS		C			B			B			A	

Intersection Summary

HCM Average Control Delay	17.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	43.7	Sum of lost time (s)	6.0
Intersection Capacity Utilization	84.9%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Timing Report, Sorted By Phase
3: HIGHLAND & WILLOW

2008-038 Summer St
2014 PM Build



Phase Number	2	4	6	8
Movement	NBTL	EBTL	SBTL	WBT
Lead/Lag				
Lead-Lag Optimize				
Recall Mode	Max	None	Max	None
Maximum Split (s)	25	20	25	20
Maximum Split (%)	55.6%	44.4%	55.6%	44.4%
Minimum Split (s)	17	9	17	9
Yellow Time (s)	2	2	2	2
All-Red Time (s)	1	1	1	1
Minimum Initial (s)	4	4	4	4
Vehicle Extension (s)	3	3	3	3
Minimum Gap (s)	3	3	3	3
Time Before Reduce (s)	0	0	0	0
Time To Reduce (s)	0	0	0	0
Walk Time (s)				
Flash Dont Walk (s)				
Dual Entry	Yes	Yes	Yes	Yes
Inhibit Max	Yes	Yes	Yes	Yes
Start Time (s)	0	25	0	25
End Time (s)	25	0	25	0
Yield/Force Off (s)	22	42	22	42
Yield/Force Off 170(s)	22	42	22	42
Local Start Time (s)	0	25	0	25
Local Yield (s)	22	42	22	42
Local Yield 170(s)	22	42	22	42

Intersection Summary

Cycle Length	45
Control Type	Actuated-Uncoordinated
Natural Cycle	40

Splits and Phases: 3: HIGHLAND & WILLOW

02	04
25 s	20 s
06	08
25 s	20 s

